REMARKS

Claims 28, 31, 35, 43, 50 and 54 have been cancelled and new claims 55-70 have been added so that claims 1-27, 29, 30, 32-34, 36-42, 44-49, 51-53 and 55-70 are now in the application. Claims 1-27 have been withdrawn from consideration.

A "Request for Drawing Amendment" accompanies this amendment.

(1) Claim 32 has been rewritten in independent form and is distinguished over the prior art by reciting:

> "the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$, wherein angles α and β are orthogonal."

These steps are shown in Figs. 17, 19, 21, 23 and 25 for the free layer structures. The Examiner rejected claim 32 under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Lin and Okuno as applied to claims 31, 33 and 36-39 and further in view of Tan. In support of his position the Examiner states:

> "The differences not yet discussed is the angles.
> Tan et al. teach oscillating the target and the substrate to achieve the ion beam sputtered angles. (Column 3 lines 49-53; Column 4 lines 65-58)
> The motivation for utilizing angles is that it allows for depositing films with uniformity in thickness. (Column 2 lines 52-56)
> Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized angles as taught by Tan et al. because it allows for depositing films with uniformity in thickness."

It should be noted that Tan does not teach oblique sputtering at angles α and β which are orthogonal with respect to one another, but in contrast teach angles α and β which are parallel with respect to one another. This is supported by column 4, line 62 to column 5, line 8 of Tan wherein it is stated:

> "It also should be noted that in contrast to the prior art sputtering mechanism illustrated in FIG. 1, there are no high voltage wirings or contacts affixed to either the target 36 or the substrate support 38. The target holder 36 can be designed with an oscillating motion signified by bidirectional arrow 42. In addition, the turntable 38A can be operated with rotating motions signified by arrow 59. Likewise, the substrate mounts 38C can be designed with rotatable motion signified by arrow 56 atop the turntable 38A. Optionally, the entire substrate support 38 can be operated in an oscillating motion as represented by bidirectional arrow 60. The motions 42, 56, 59 and 60 are all designed to achieve uniform film thickness on the substrate 50."

As can be seen from FIG. 2 of Tan the target 40 can be rotated along arc 42 about pivot 36D while the substrate 38 can be rotated along 60 about unnumbered pivot point near 38B. Both of the angles along arc 42 and 60 are within the same plane and are not orthogonal as recited in claim 32. Accordingly, claim 32 is clearly distinguished over the references.

Claims 28-30 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Okuno. Claim 29 has been rewritten in independent form and is distinguished over these references by reciting:

> "obliquely ion beam sputtering at least one cobalt or cobalt based layer with a magnetic moment and an easy axis in the presence of a magnetic field oriented in a direction of the easy axis; and
> annealing said at least one cobalt or cobalt based layer after said ion beam sputtering."

In support of his position the Examiner refers to column 8, lines 27-33 of Tan. However, column 8, lines 21-26 are also pertinent to the teaching of Tan. Column 8, lines 21-33 of Tan state:

> "An Fe/Cr artificial multilayer of $(t_{Fe}/t_{Cr})_n=(2.5/1.3)_{30}$ was manufactured on a quartz glass substrate (at room temperature) by the similar method to that of Example 1 except that the magnetic field is not applied. The saturated magnetic field of the artificial multilayer was 2.7 kOe.
> Then, the artificial multilayer was heat treated at 50°C. in vacuum in a magnetic field. With regard to the obtained artificial multilayer, the saturated magnetic field was reduced to 2.2 kOe when the external magnetic field was applied in the direction of easy axis, while was increased to 3.2 kOe when the external magnetic field was applied in the direction of difficult axis."

It should be noted that this teaching of Tan states that the "magnetic field is not applied" when the artificial multilayer is formed. Accordingly, claim 29 is clearly distinguished over Tan by reciting oblique ion beam sputtering a cobalt or cobalt-based layer in the presence of a magnetic field which is oriented in the direction of the easy axis. Claim 30, which is dependent upon claim 29, is considered to be patentable over the references for the same reasons as given in support for claim 29.

Claims 31, 33 and 36-39 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Lin and Okuno. Claim 33 has been amended to be in independent form and is distinguished over these references by reciting:

> "forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis; and
>
> after said oblique ion beam sputtering in the presence of said field oriented in said direction of the easy axis, further forming said at least one cobalt or cobalt based layer by annealing said at least one cobalt or cobalt based layer."

Claim 33 is considered to be patentable over the references for the same reasons as given in support for claim 29.

Claims 36-39, which are dependent upon claim 32, are considered to be patentable over the references for the same reasons as given in support for claim 32. Claim 37 is further distinguished over the references for the same reasons as given in support for claim 29.

Claims 34 and 35 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Lin and Okuno and further in view of Tan and further in view of Fujikata. Claim 34 is distinguished over these references by reciting: 3

> "the pinning layer structure is formed by forming a nickel oxide (NiO) layer and an alpha iron oxide (α FeO) layer wherein at least one of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering; and
>
> each of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering."

This structure is shown in Figs. 28 and 29 and is discussed from page 19, line 23 to page 20, line 6 of Applicant's specification. In support of his position the Examiner states:

> "Fujikata et al. teach utilizing an antiferromagnetic thin film comprised of a two-layer structure composed of a CoO layer deposited on a NiO layer. (See Abstract) As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe2O3, FeO, CrO, and MnO are preferred. (Column 6 lines 2-5)
>
> The motivation for utilizing a two layer structure is that it allows for avoiding Barkhausen jumps. (Column 6 line 1)"

Fujikata refers to placing a ferric oxide layer next to the second ferromagnetic layer for magnetically stabilizing that layer. The Examiner's attention is respectfully invited to column 1, lines 30-37 and column 5, line 60 to column 6, line 11 of Fujikata wherein it is stated:

> "Recently, proposal is made of a magnetoresistance effect film which comprises at least two ferromagnetic layers or thin films stacked one over the other with a nonmagnetic layer or thin film interposed therebetween, and an antiferromagnetic layer or thin film underlying a first one of the ferromagnetic thin films so that the first ferromagnetic thin film is provided with antimagnetic force, that is, constrained by exchange anisotropy or exchange biasing.
>
> . . . .
>
> In the above-mentioned magnetoresistance effect film, an additional antiferromagnetic layer or a permanent magnet layer may be arranged adjacent to the second ferromagnetic layer which is for detecting the external magnetic field so that a biasing magnetic direction by the permanent magnet or the additional antiferromagnetic layer is in the direction of the easy magnetization axis of the second ferromagnetic layer. With this structure, magnetic domains of the second ferromagnetic layer can be stabilized so that nonlinear outputs such as Barkhausen jumps can be avoided. As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe_2O_3, FeO, CrO, and MnO are preferred. As the permanent magnet layer, those materials such as CoCr, CoCrTa, CoCrTaPt, CoCrPt, CoNiPt, CoNiCr, CoCrPtSi, and FeCoCr are preferred. Furthermore, Cr or the like may be used as a primer or an underlying layer for the permanent magnet layer."

In the first part of the quote Fujikata refers to a first ferromagnetic thin film which is pinned by a ferromagnetic layer and a second ferromagnetic layer wherein the first and second ferromagnetic layers are spaced apart by a nonmagnetic spacer layer. The latter part of the quote refers to placing a ferric oxide layer next to the second ferromagnetic layer which is the free layer and not the pinned layer. Claim 34 recites the ferric oxide layer as being part of the pinning layer structure in contrast to being located next to the free layer as taught by Fujikata. Accordingly, claim 34 is clearly distinguished over the references.

Claim 40 was rejected under 35 USC 103(a) as being unpatentable over Lin in view of Fujikata and Pinarbasi. Claim 40 is considered to be patentable over the references for the same reasons as given in support for claim 34.

Claim 43 was rejected under 35 USC 103(a) as being unpatentable over Lin in view of Pinarbasi, further in view of Fujikata and further in view of Okuno. Claim 41 has been amended to include the limitation from claim 43 and is considered to be patentable over the references for the same reasons as given in support for claim 29.

Claim 42 was rejected under 35 USC 103(a) as being unpatentable over Lin in view of Pinarbasi and further in view of Fujikata. Claim 42, which is dependent upon claim 41, is considered to be patentable over these references for the same reasons as given in support for claim 41.

Claims 44-47 were rejected under 35 USC 103(a) in view of Lin in view of Pinarbasi, further in view of Fujikata, further in view of Okuno and further in view of Tan. Claims 44 and 45, which are dependent upon claim 42, are considered to be patentable over these references for the same reasons as given in support for claim 42. Claim 45 is further distinguished over the references for the same reasons as given in support for claim 32. Claim 46 is considered to be patentable over the references for the same reasons as given in support for claim 42 and claim 47 is further distinguished over the references for the same reasons as given in support for claim 45.

Claims 48-51 were rejected under 35 USC 103(a) as being unpatentable in view of Pinarbasi and Okuno. Claim 48 has been amended to include the limitation from claim 50 and is considered to be patentable over the references for the same reasons as given in support for claim 29. Claims 49 and 51 are considered to be patentable over the references for the same reasons as given in support for claim 48.

Claims 52-54 were rejected under 35 USC 103(a) as being unpatentable over Lin in view of Pinarbasi and Okuno and further in view of Tan. Claim 52, which is dependent upon claim 51, is further considered to be patentable over these references for the same reasons as given in support for claim 32. Claim 53 is considered to be patentable over the references for the same reasons as given in support for claim 52.

New claims 55-70 have been added to the application. Claim 55 is distinguished over the references by reciting:

> "the oblique ion beam sputtering being at angles α and β wherein each angle α and β is acute and wherein the angles α and β are orthogonal with respect to each other."

As stated hereinabove, none of these references teaches oblique ion beam sputtering at angles α and β wherein each angle α and β is acute and wherein the angles α and β are orthogonal with respect to each other. In contrast, in the Tan reference the angles lie within the same plane, as shown in Fig. 2 thereof.

Claims 56-70, which are dependent upon claim 55, are considered to be patentable over the references for the same reasons as given in support for similar claims hereinabove.

Should the Examiner have any questions regarding this Amendment he is respectfully requested to contact the undersigned.

Respectfully submitted,

By: Ervin F. Johnston
Attorney for Applicant(s)
Registration No. 20,190
Telephone: 619-334-5883
Fax: 619-448-1904

ATTACHMENT

In the claims:

Cancel claims 28, 31, 35, 43, 50 and 54.

Amend claims 29, 32, 33, 34, 36, 38, 41, 44, 48 and 51.

29. (Once Amended) [A method as claimed in claim 28 including the further step of] A method of making a magnetic component for an electrical device comprising:

obliquely ion beam sputtering at least one cobalt or cobalt based layer with a magnetic moment and an easy axis in the presence of a magnetic field oriented in a direction of the easy axis; and

annealing said at least one cobalt or cobalt based layer after said ion beam sputtering. [in the presence of said magnetic field oriented in said direction of the easy axis.]

32. (Once Amended) [A method as claimed in claim 31 wherein] A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis; and

the oblique ion beam sputtering [is] being at angles $\alpha = 40°$ and $\beta = 10° - 30°$, wherein angles α and β are orthogonal.

33. (Once Amended) [A method as claimed in claim 31 further comprising the step of:] A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis; and

after said oblique ion beam sputtering in the presence of said field oriented in said direction of the easy axis, further forming said at least one cobalt or cobalt based layer by annealing said at least one cobalt or cobalt based layer.

34. (Once Amended) [A method as claimed in claim 31 wherein] A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis;

the pinning layer structure [is] being formed by forming a nickel oxide (NiO) layer and an alpha iron oxide (α FeO) layer wherein [at least one of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering.] each of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering.

36. (Once Amended) A method as claimed in claim [31] 32 further comprising the steps of:

forming the free layer structure with a nickel iron based layer that interfaces the cobalt or cobalt based layer; and

said forming of the cobalt or cobalt based layer so that it interfaces the spacer layer.

38. (Once Amended) A method as claimed in claim [37] 36 wherein said cobalt based layer is formed of cobalt iron (CoFe).

41. (Once Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising:

a making of the spin valve sensor including the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure; [and]

a making the free layer structure including the steps of:

obliquely ion beam sputtering first and second cobalt or cobalt based layers and a nickel iron based layer in the presence of a magnetic field oriented in a direction of said easy axis with the first and second cobalt or cobalt based layers interfacing the spacer layer and a cap layer respectively and the nickel iron based layer being located between and interfacing the first and second cobalt or cobalt based layers[.]; and

after said oblique ion beam sputtering in the presence of said field oriented in said direction on the easy axis, annealing each of the cobalt or cobalt based layers and the nickel iron based layer.

44. (Once Amended) A method as claimed in claim [43] 42 wherein a forming of the pinned layer structure comprises the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned layers with the first AP layer interfacing the pinning layer; and

forming an antiparallel (AP) coupling layer between the first and second AP layers.

48. (Once Amended) A method of making magnetic head assembly that includes a write head and a read head, comprising the steps of:

a making of the write head including:

forming ferromagnetic first and second pole piece layers in pole tip, yoke and back gap regions wherein the yoke region is located between the pole tip and back gap regions;

forming a nonmagnetic nonconductive write gap layer between the first and second pole piece layers in the pole tip region;

forming an insulation stack with at least one coil layer embedded therein between the first and second pole piece layers in the yoke region; and

connecting the first and pole piece layers at said back gap region; and

making the read head as follows:

forming a spin valve sensor and first and second nonmagnetic first and second read gap layers with the spin valve sensor located between the first and second read gap layers;

forming a ferromagnetic first shield layer; and

forming the first and second read gap layers between the first shield layer and the first pole piece layer; and

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure; [and]

a making of the free layer structure including the step of:

obliquely ion beam sputtering first and second cobalt or cobalt based layers and a nickel iron based layer in the presence of a magnetic field oriented in a direction of said easy axis with the first and second cobalt or cobalt based layers interfacing the spacer layer structure and a gap layer respectively and the nickel iron based layer being located between and interfacing the first and second cobalt or cobalt based layers[.]; and

after said oblique ion beam sputtering in the presence of said field oriented in said direction of the easy axis, annealing each of the cobalt or cobalt based layers and the nickel iron based layer.

51. (Once Amended) A method as claimed in claim [50] 49 wherein a forming of the pinned layer structure comprises the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer; and

forming an antiparallel (AP) coupling layer located between the first and second AP layers.

Add new claims 55-70.

55. (New) A method of making a magnetic layer and/or an antiferromagnetic (AFM) layer for an electrical device comprising the steps of:

obliquely ion beam sputtering at least one material layer from a target onto a substrate to form said magnetic layer and/or antiferromagnetic (AFM) layer;

the oblique ion beam sputtering being at angles α and β wherein each angle α and β is acute and wherein the angles α and β are orthogonal with respect to each other.

56. (New) A method as claimed in claim 55 wherein the angle β is 10° to 30°.

Sub D F1

57. (New) A method as claimed in claim 55 wherein the angle β is 20° and the angle α is 40°.

58. (New) A method as claimed in claim 55 wherein the angle β is 30° and the angle α is 40°.

Sub C6

59. (New) A method as claimed in claim 55 wherein said at least one material layer is a nickel iron film and first and second cobalt based films with the nickel iron layer being located between the first and second cobalt based films for forming said magnetic layer.

A9 Cont'd

60. (New) A method as claimed in claim 59 wherein a second material layer comprising a nickel oxide film and an α phase iron oxide film that interface one another are obliquely ion beam sputtered at said angles α and β for forming said antiferromagnetic layer.

Sub F1

61. (New) A method as claimed in claim 60 wherein for each of said magnetic and AFM layers the angle β is 10° to 30°.

62. (New) A method as claimed in claim 61 wherein for said magnetic layer the angle β is 20° and the angle α is 40°.

Sub C7

63. (New) A method as claimed in claim 55 wherein the electrical device is a magnetic head assembly and further comprises the steps of:

said at least one magnetic layer being a ferromagnetic free layer;

a ferromagnetic pinned layer;

a nonmagnetic spacer layer located between the free and pinned layers; and

the pinned and spacer layers being ion beam sputtered at an angle α which is acute and at an angle β which is zero.

Sub D10

64. (New) A method as claimed in claim 63 wherein for the free layer the angle β is 10° to 30°.

65. (New) A method as claimed in claim 64 wherein the free layer has a magnetic moment with an easy axis and the oblique sputtering of the free layer is done in the presence of a magnetic field oriented parallel to said easy axis.

66. (New) A method as claimed in claim 65 wherein after oblique sputtering the free layer the free layer is annealed at a temperature from 150°C to 270°C in the presence of said field oriented parallel to said easy axis.

Sub F17

67. (New) A method as claimed in claim 66 wherein for the free layer the angle β is 20° and the angle α is 40°.

A9 Cont'd

68. (New) A method as claimed in claim 67 wherein for the pinned and spacer layers angle α is 40° and angle β is 0°.

69. (New) A method as claimed in claim 68 further including the steps of:

Sub D11

forming said antiferromagnetic (AFM) layer interfacing the pinned layer wherein the AFM layer includes a nickel oxide film and an α phase iron oxide film that interface one another; and

ion beam sputtering the nickel oxide film and the α phase iron oxide film at angles α and β wherein each angle α and β are acute and wherein the angles α and β are orthogonal with respect to one another.

Sub F1

70. (New) A method as claimed in claim 69 wherein for the AFM layer the angle α is 40° and angle β is 10° - 30°.